Center for
Human-Machine-Interaction

German
Research Center
for Artificial
Intelligence

IFS Innovative
Factory Systems

# Model-Based Useware Engineering

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W3C Workshop on Future Standards for Model-Based User Interfaces
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# Introduction

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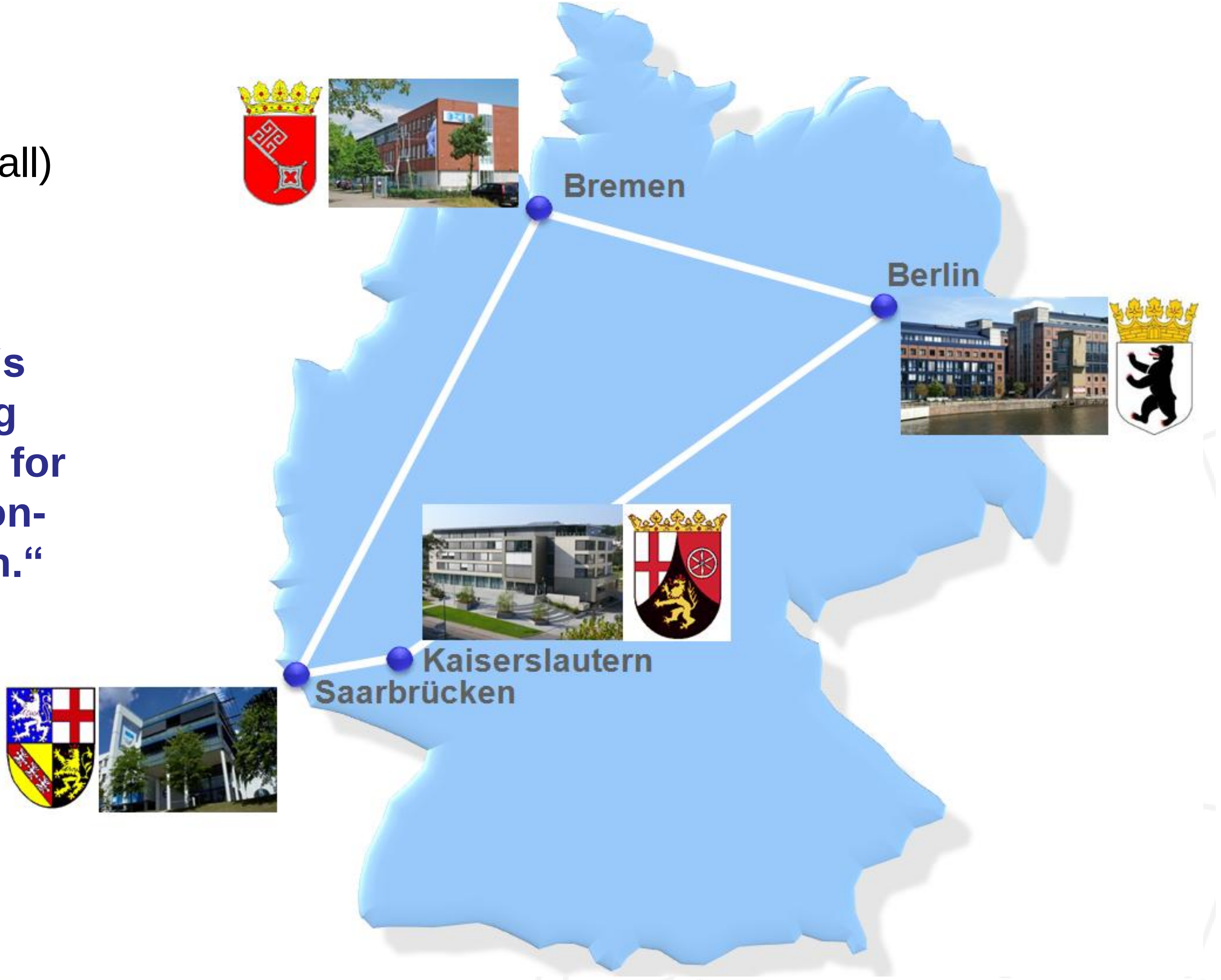
# DFKI - The Quadrangle of Innovation

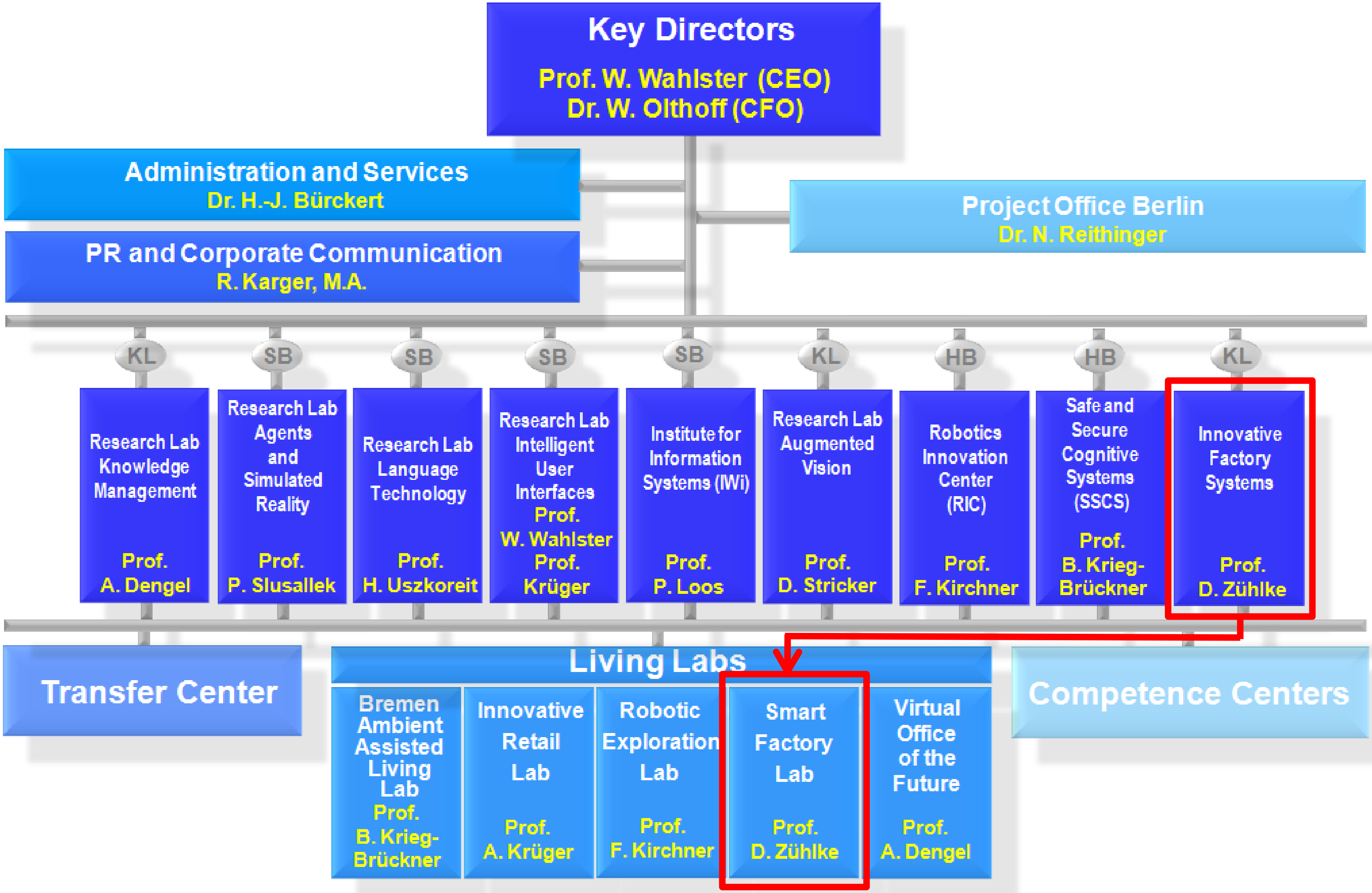
April 2010:

- 753 employees (overall)
- 260 Researcher
- 116 ongoing projects

**„DFKI is the world‘s largest and leading Center of Excellence for basic and application-oriented AI research.“**



# The Structure of the DFKI



**Key Directors**

Prof. W. Wahlster (CEO)
Dr. W. Olthoff (CFO)

**Administration and Services**
Dr. H.-J. Bürckert

**PR and Corporate Communication**
R. Karger, M.A.

**Project Office Berlin**
Dr. N. Reithinger

- KL: Research Lab Knowledge Management, Prof. A. Dengel
- SB: Research Lab Agents and Simulated Reality, Prof. P. Slusallek
- SB: Research Lab Language Technology, Prof. H. Uszkoreit
- SB: Research Lab Intelligent User Interfaces, Prof. W. Wahlster, Prof. Krüger
- SB: Institute for Information Systems (IWi), Prof. P. Loos
- KL: Research Lab Augmented Vision, Prof. D. Stricker
- HB: Robotics Innovation Center (RIC), Prof. F. Kirchner
- HB: Safe and Secure Cognitive Systems (SSCS), Prof. B. Krieg-Brückner
- KL: Innovative Factory Systems, Prof. D. Zühlke

**Transfer Center**

**Living Labs**

- Bremen Ambient Assisted Living Lab, Prof. B. Krieg-Brückner
- Innovative Retail Lab, Prof. A. Krüger
- Robotic Exploration Lab, Prof. F. Kirchner
- Smart Factory Lab, Prof. D. Zühlke
- Virtual Office of the Future, Prof. A. Dengel

**Competence Centers**

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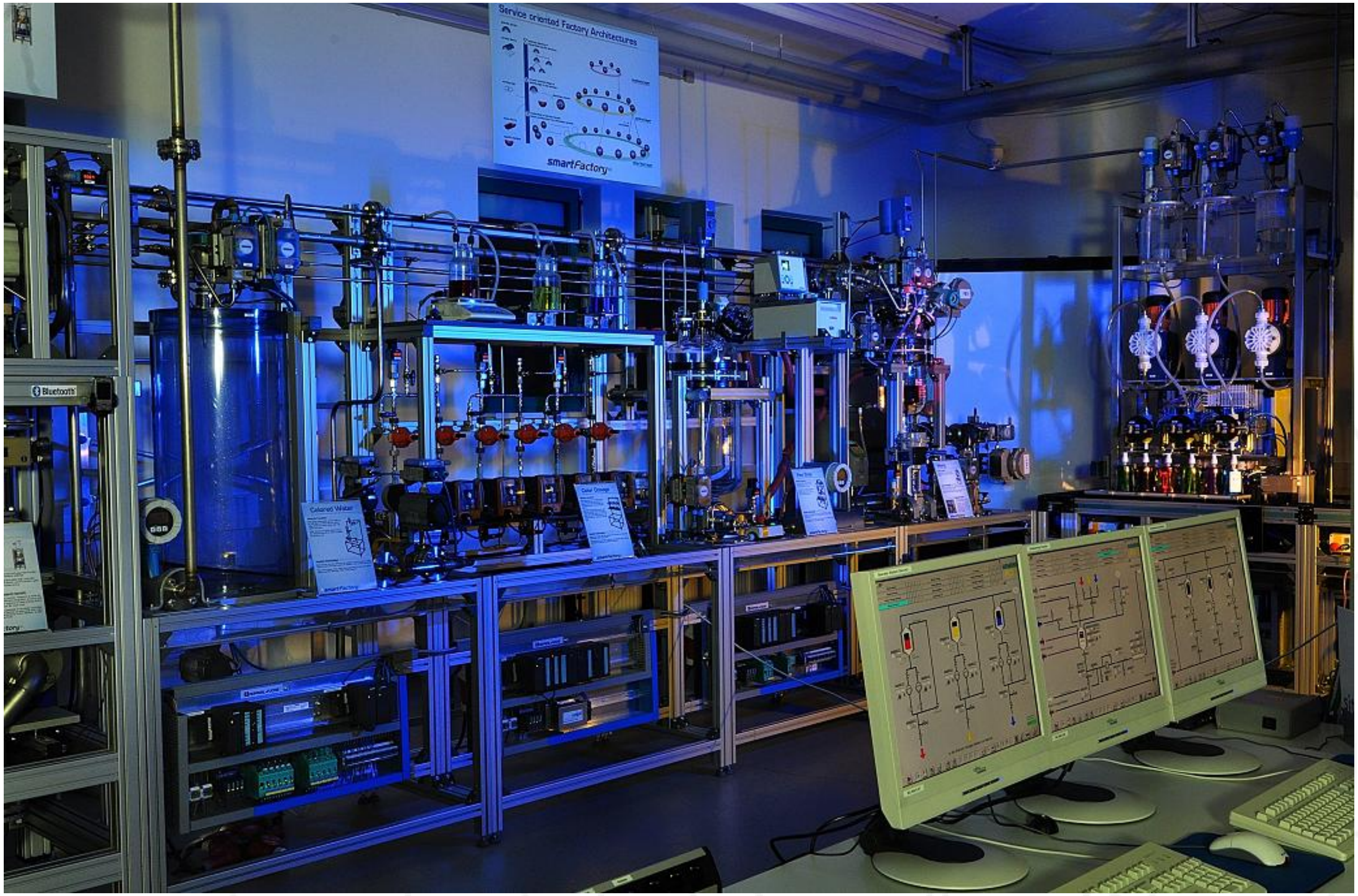
# Living Lab - SmartFactory



- First multi vendor research, development and  demonstration center for industrial ICT
  - **Goal:** The integration of mature ICT into factory automation

## MBUID Use Cases

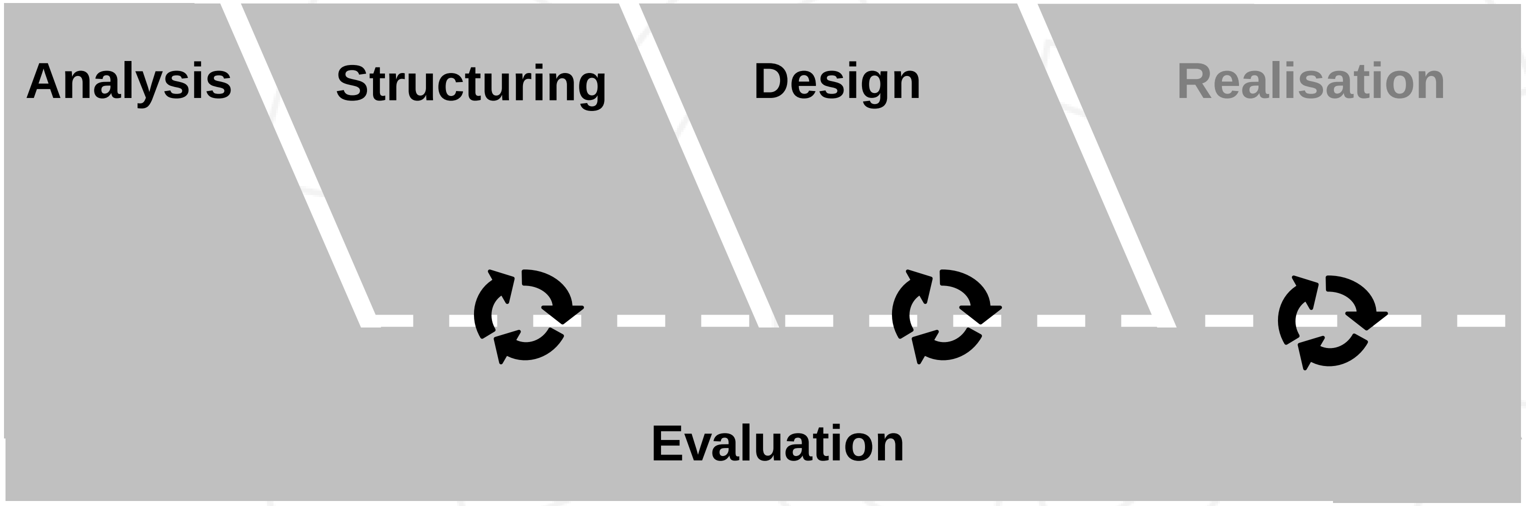
1. Industrial Projects: Usability Engineering
   - @**Development**-time
   - User-centered development process **+**
     Model-based user interface development methodology
   - ➢ Supporting project staff with tools (e.g. prototyping, code generators)

2. Configuration and maintaining of industrial devices
   - @**Run**-time
   - Automatic UI generation
   - Adaptive UIs
   - ➢ Ad-hoc access to devices via one universal interaction device (instead of using many different devices)

# MBUID@Development-time

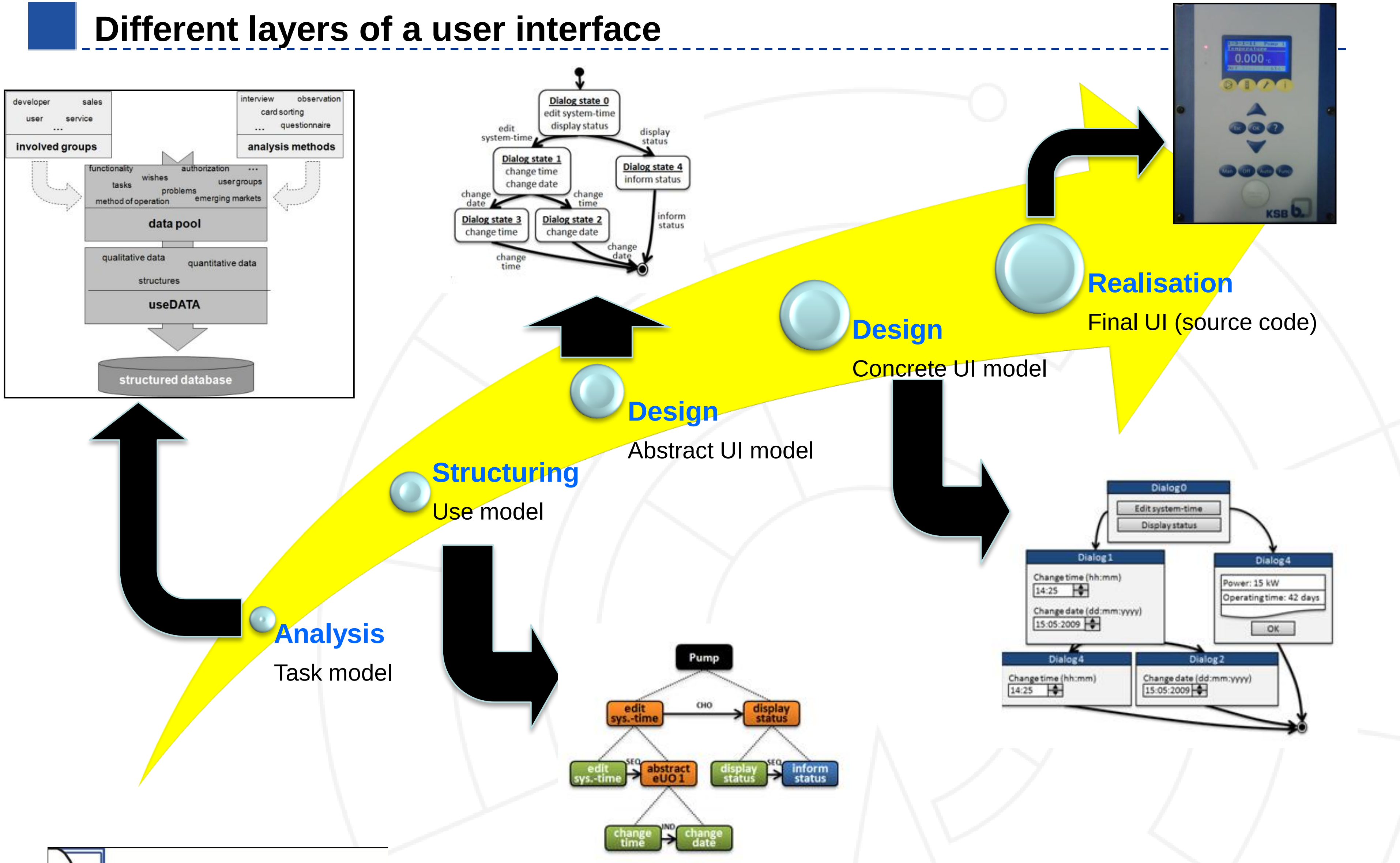
## Useware Engineering Process

- Incorporates users and clients into all project phases (Iterative)
- Different (overlapping) main phases:
  - **Analysis**: Understanding the users, their tasks and the context-of-use
  - **Structuring**: Deduction of a single, harmonized task structure
  - **Design**: Deduction of abstract & concrete UIs
  - **Evaluation**: Iterative testing of mock-ups/prototypes with users



→ Approved in many different research- and industrial projects since 1991

# Different layers of a user interface



**Analysis**
Task model

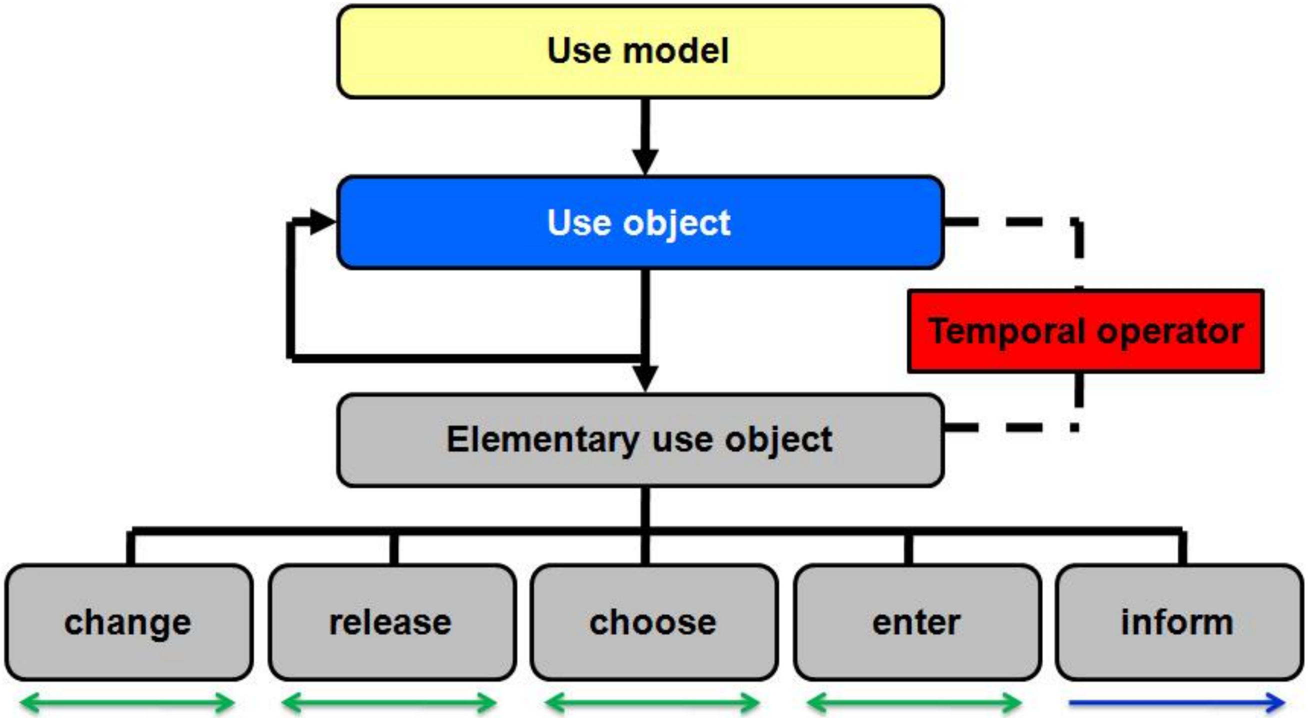
**Structuring**
Use model

**Design**
Abstract UI model

**Design**
Concrete UI model

**Realisation**
Final UI (source code)

# Useware Markup Language (useML) 2.0

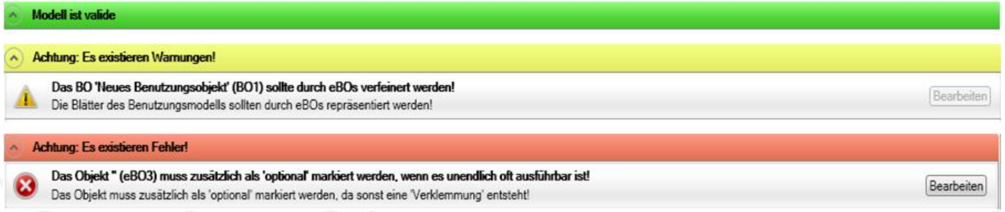


- Different tasks types (e.g. system task, interactive task)
- Elementary use objects --> more detailed specification of interactive tasks
- Optionality and Cardinality
- Logical and temporal conditions (pre-conditions, invariants, post-conditions)
- 5 Temporal Operators

# Udit – useML-Editor (1/3)

Features:

- Udit supports the whole expressiveness of useML 2.0
- Integrated semantic model checker (e.g. warning, error)



Modell ist valide

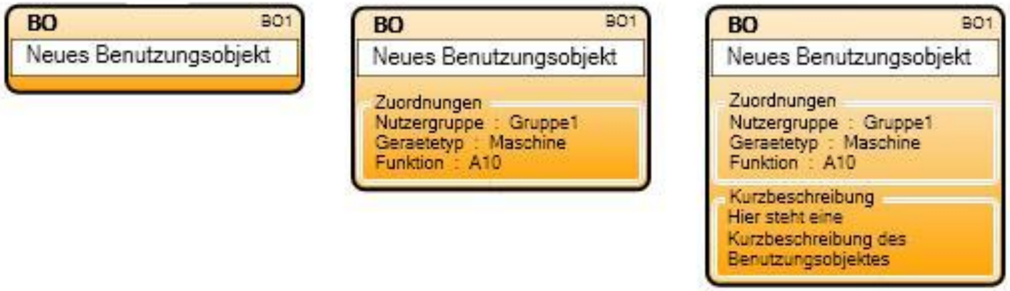
Achtung: Es existieren Warnungen!

⚠ Das BO 'Neues Benutzungsobjekt' (BO1) sollte durch eBOs verfeinert werden!
Die Blätter des Benutzungsmodells sollten durch eBOs repräsentiert werden!

Achtung: Es existieren Fehler!

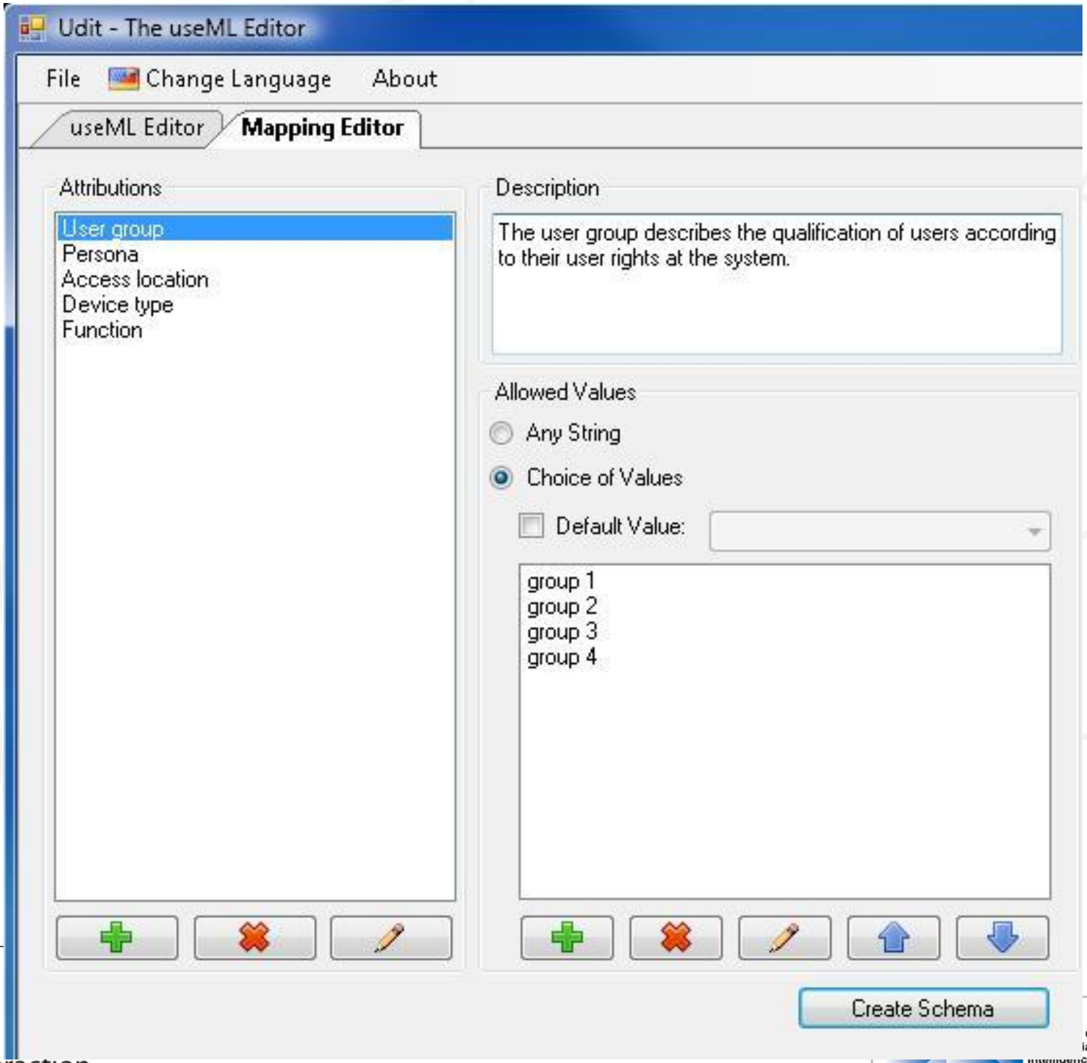
ⓧ Das Objekt '' (eBO3) muss zusätzlich als 'optional' markiert werden, wenn es unendlich oft ausführbar ist!
Das Objekt muss zusätzlich als 'optional' markiert werden, da sonst eine 'Verklemmung' entsteht!

- Multilingual (German/ English/ …)
- Export of use models (DISL, figure, direct print)
- Expand nodes (display / hide sub-tasks)
- 3 level of detail



# Udit – useML-Editor (2/3)

- Project-specific adaption is possible (user group, access location, device type, etc.)



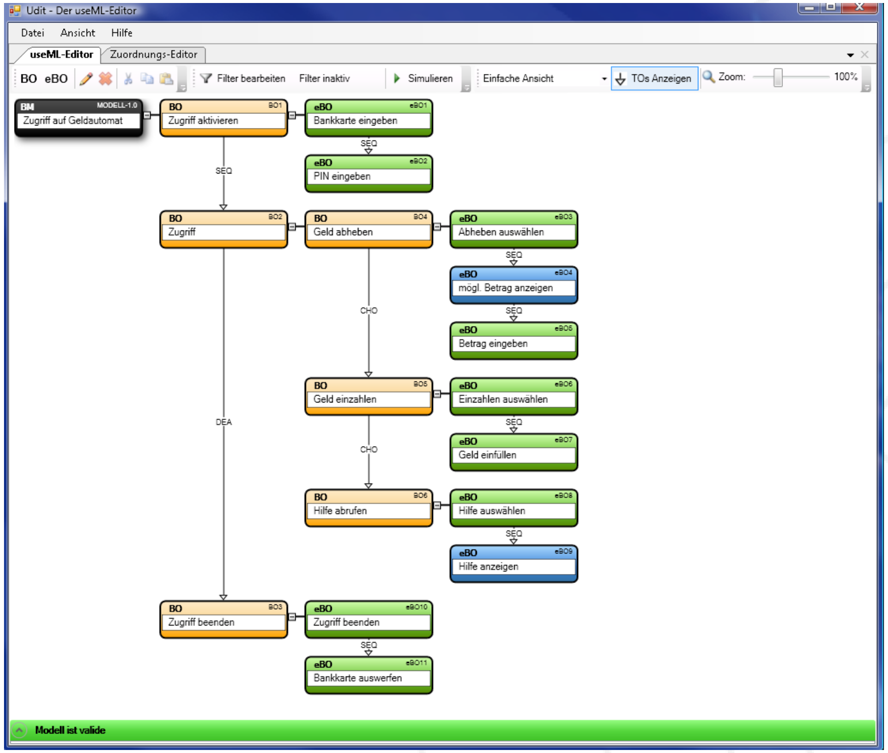
The user group describes the qualification of users according to their user rights at the system.

○ Any String
● Choice of Values
□ Default Value:

group 1
group 2
group 3
group 4

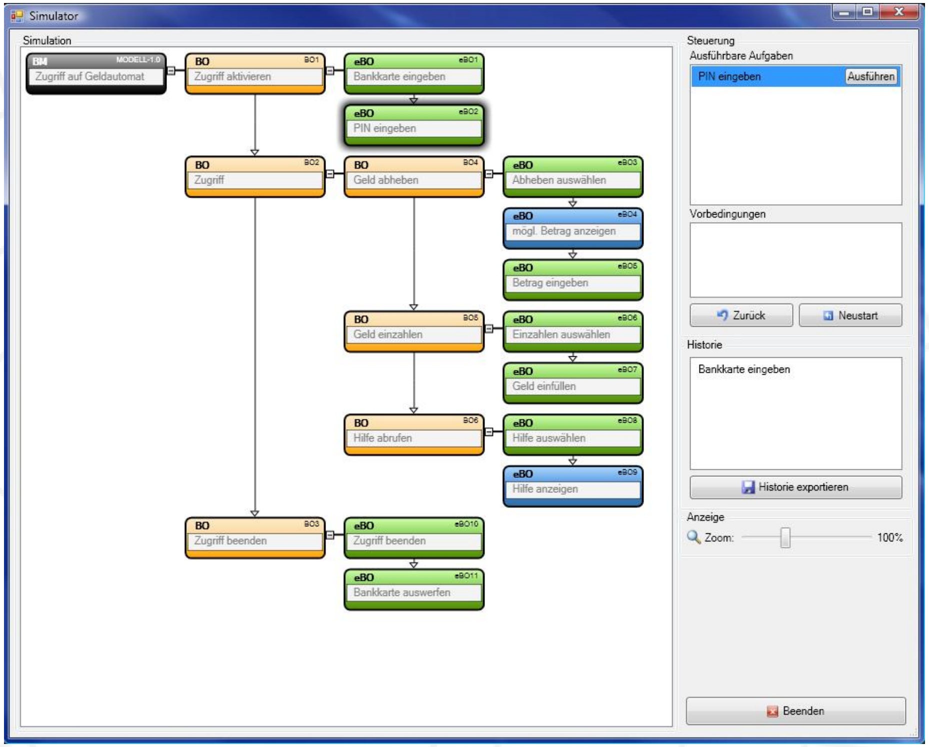
# Udit – useML-Editor (3/3)

## Editor



Modell ist valide

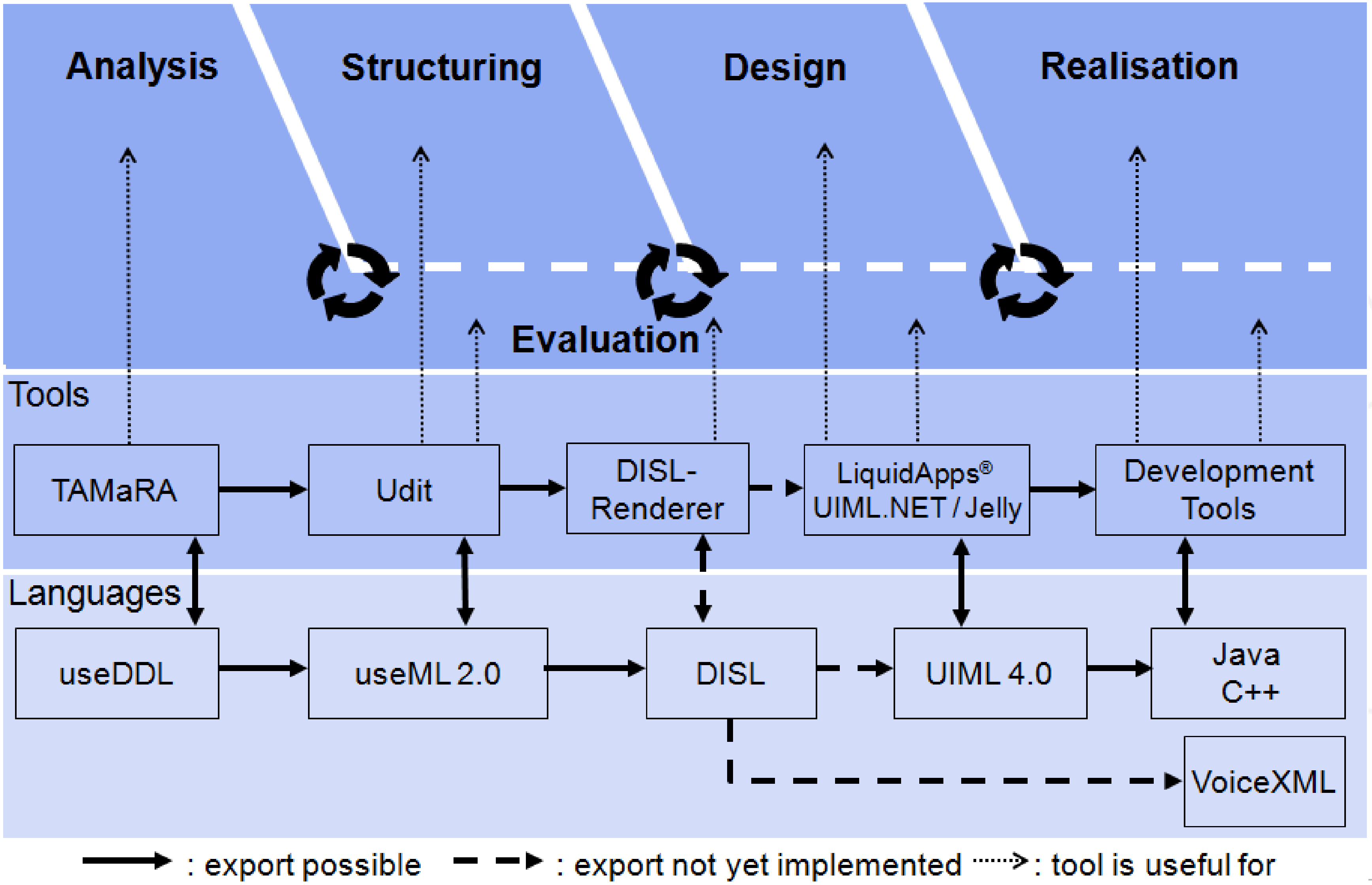
## Simulator



Ausführbare Aufgaben: PIN eingeben

Historie: Bankkarte eingeben

## MBUID Toolchain



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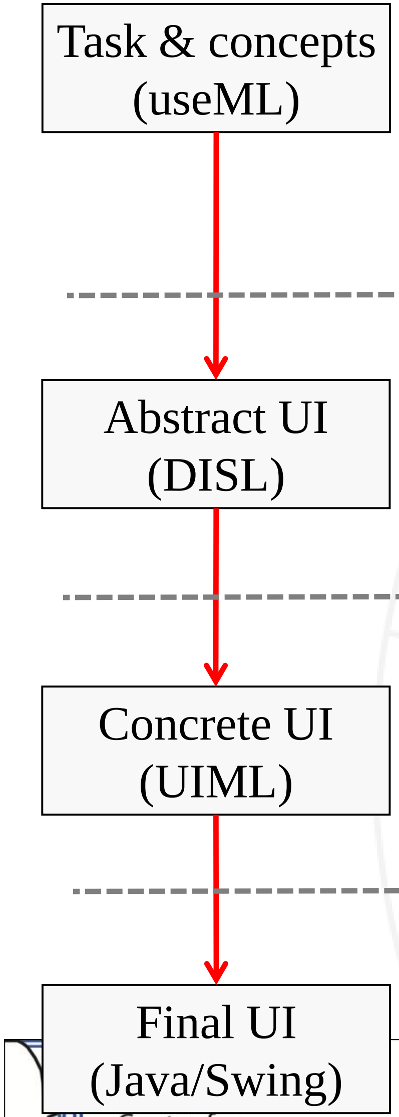
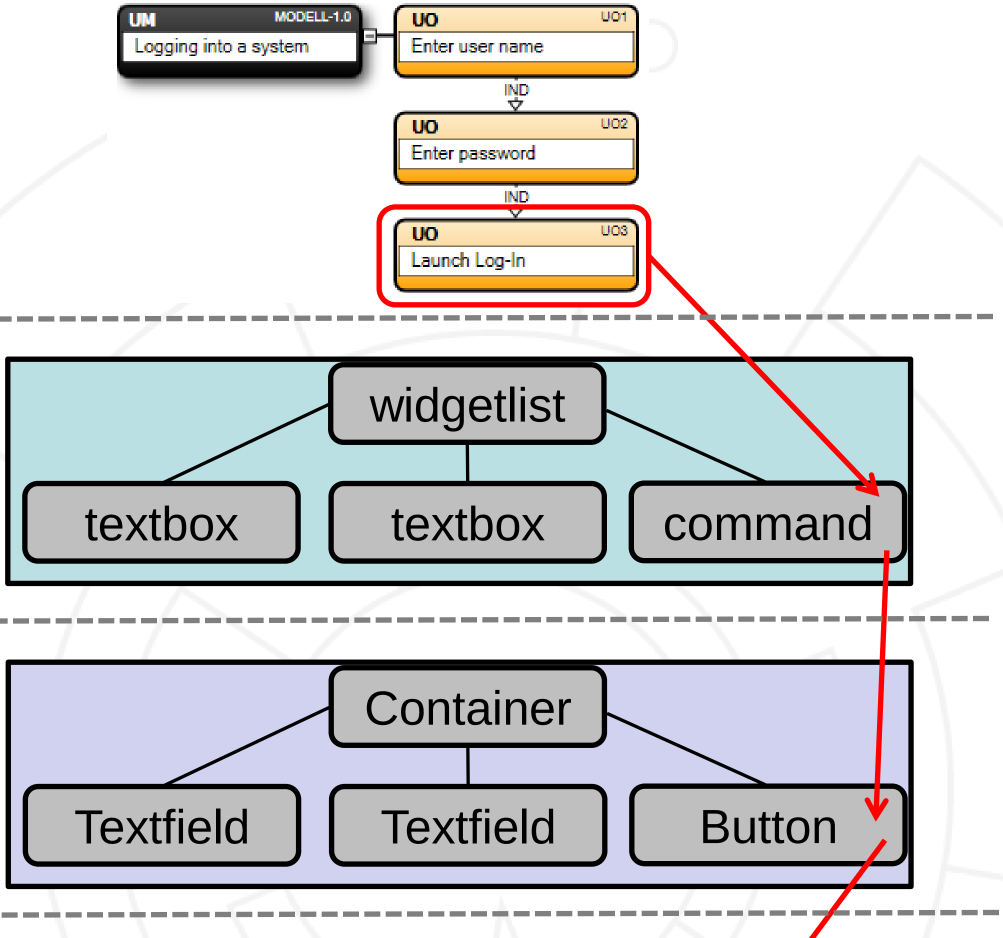
# Example of our MBUID-approach

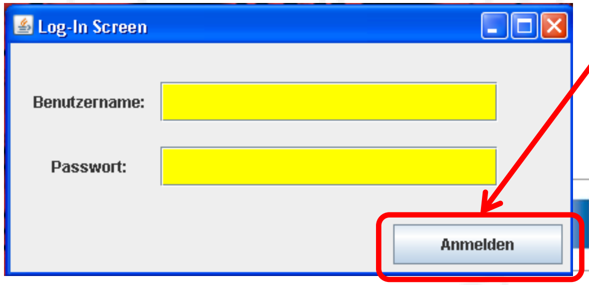

Task & concepts (useML)

Abstract UI (DISL)

Concrete UI (UIML)

Final UI (Java/Swing)




Log-In Screen

Benutzername:

Passwort:

Anmelden

# MBUID@Run-time

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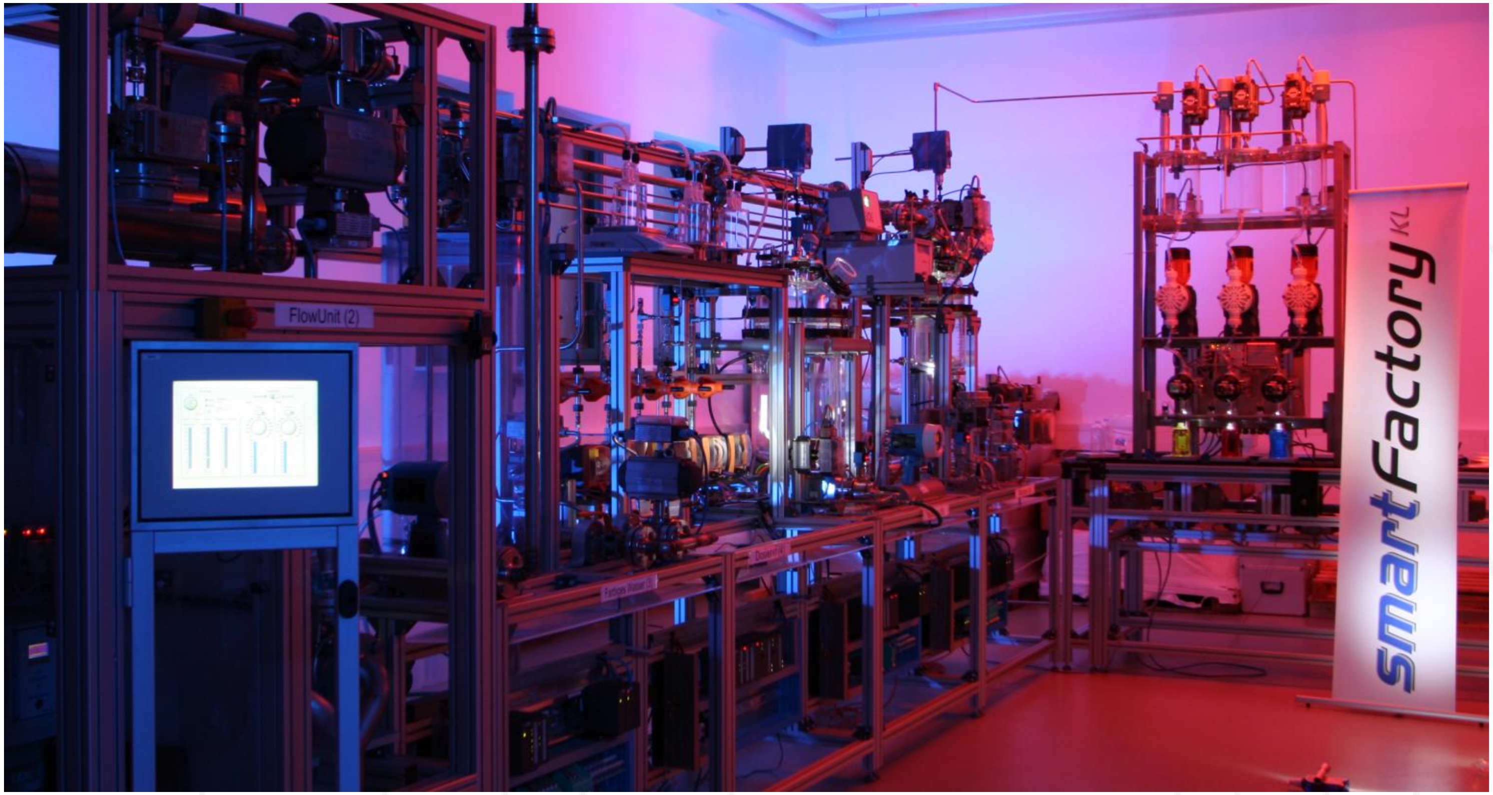
## MBUID@Run-time



Future Ambient Intelligent Production Environments still consist of many Actors, Sensors …

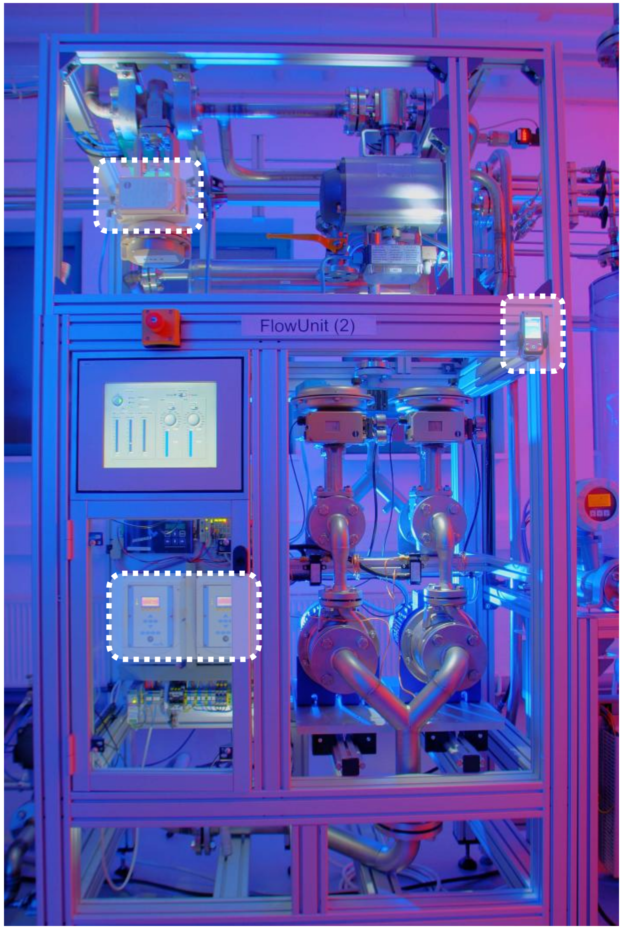
➔ **Devices have to be maintained**

# MBUID@Run-time

➔ **Devices have to be maintained**

## Today's problems…

- **Bad Accessibility**
  E.g. many devices are located > 2m above the floor



# MBUID@Run-time

➔ **Devices have to be maintained**

**Today's problems…**

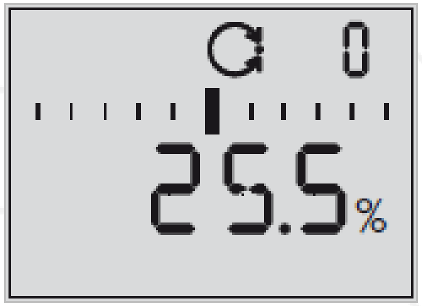
- **Bad Accessibility**
  E.g. many devices are located > 2m above the floor
- **Minimalistic User Interfaces**
  UIs usually consist of small displays and few buttons

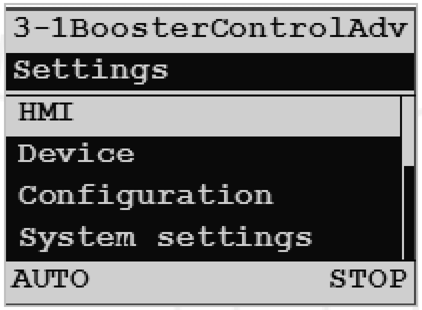
# MBUID@Run-time

➔ **Devices have to be maintained**

## Today’s problems…

- **Bad Accessibility**
  E.g. many devices are located > 2m above the floor
- **Minimalistic User Interfaces**
  UIs usually consist of small displays and few buttons
- **Proprietary User Interfaces**
  Each UI has its‘ own menu structure, layout, behavior…





3-1BoosterControlAdv

Settings

HMI

Device

Configuration

System settings

AUTO STOP

# SmartMote

**➔ SmartMote: A remote control for Intelligent Production Environments**

## Key Features:

✓ **Task-centered**
Each UI is described in a use model, describing the users tasks

✓ **Adaptive**
The UI is generated at run-time and adapts to the users context-of-use (e.g. access location)

✓ **Wireless**
The SmartMote uses Bluetooth & WLAN for a seamless device communication

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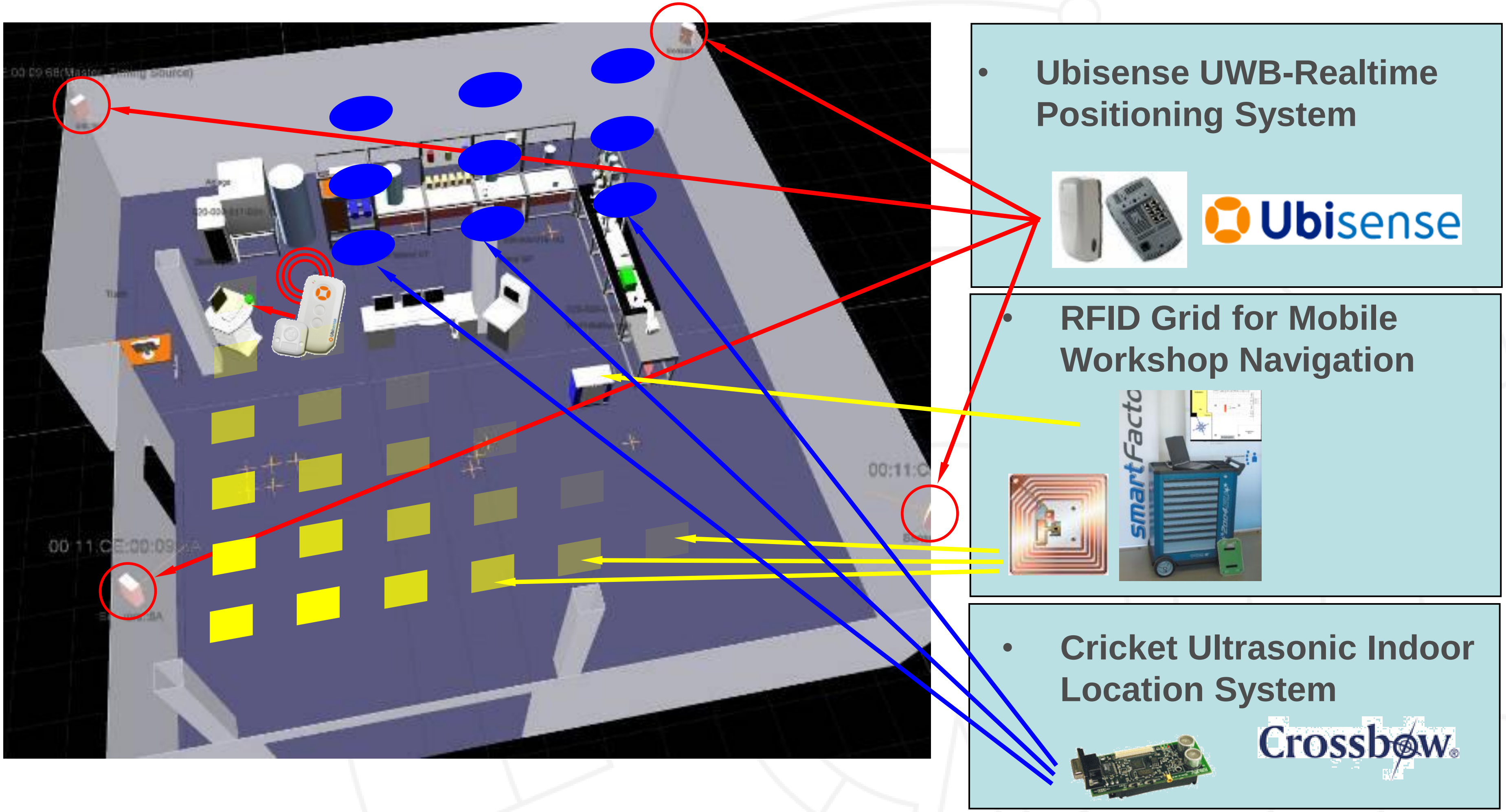
# Indoor Positioning Systems installed in the *SmartFactory*$^{KL}$

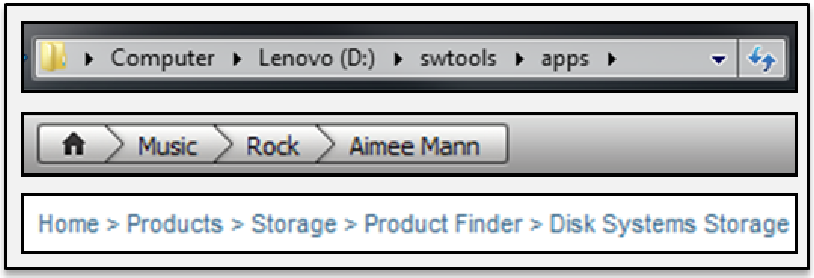


- Ubisense UWB-Realtime Positioning System
- RFID Grid for Mobile Workshop Navigation
- Cricket Ultrasonic Indoor Location System

# Improving the quality of the generated UI

## ➔ Using HCI-patterns to improve usability of run-time generated UIs

- HCI-Patterns are **proven solutions for recurring problems**
- Focus on **When**, **Why** and **How** a solution should be applied
- Primary domain: **webdesign**

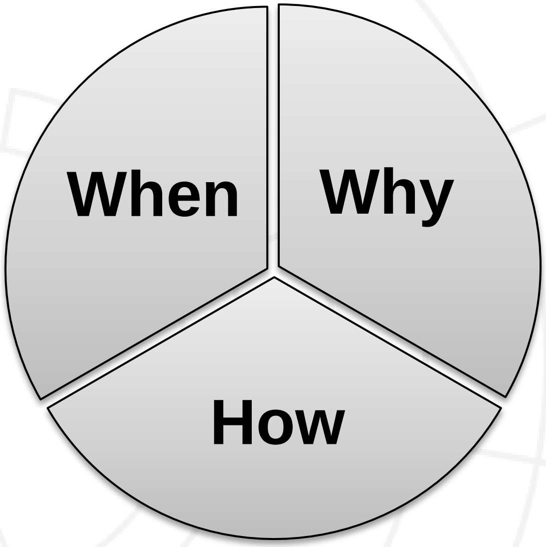

Computer ▸ Lenovo (D:) ▸ swtools ▸ apps ▸
Music > Rock > Aimee Mann
Home > Products > Storage > Product Finder > Disk Systems Storage

Breadcrumb Pattern

## So, what's the deal?!

**× HCI-Patterns still lack in formalization!**

**➔ Run-Time generation demands for a machine-processable pattern form**

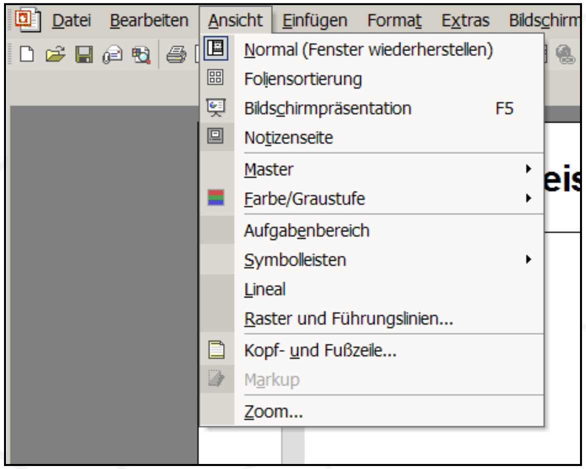


# Norms, Standards and Guidelines

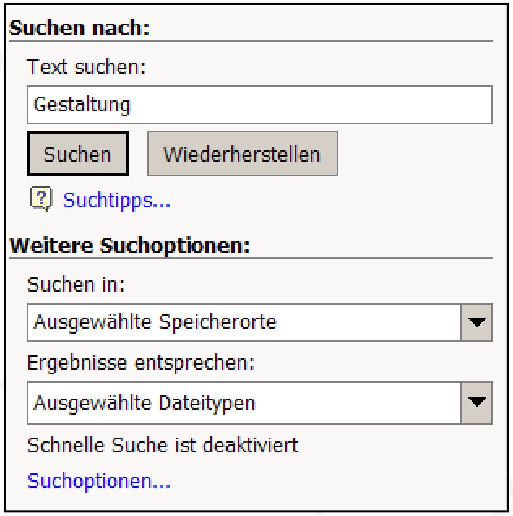
ISO 9241

VDI/VDE 3850

...



Menu (ISO 9241-14)



**Suchen nach:**

Text suchen: Gestaltung

**Weitere Suchoptionen:**

Suchen in: Ausgewählte Speicherorte

Ergebnisse entsprechen: Ausgewählte Dateitypen

Schnelle Suche ist deaktiviert

Form (ISO 9241-16)

- Overall aim: maintain principles of good GUI design
- Problem: guidelines are often not followed or interpreted correctly
- Reasons:
  - too abstract → no instant answers to the designer’s questions
  - too complex → too difficult to understand
  - too expansive → too time consuming to read

→ Solution: automatic verification of GUI guidelines

# Thanks for your attention

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## Contact

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